7th ASEP IWG, 20-22 March, 2018.
Changchun, China.

Introduction of proof tests for ASEP and ECE R51

Test items

- ECE R51-03 method B for OICA model
- GB 1495-201X
- ASEP tests for OICA model
- Influence of test mass on method B
- Simplification methods
- Method B with median speed China automotive test cycle (CATC) normal distribution
- Typical noise tests at the speed with related China test cycle gears
- Engine noise for OICA model
- Tyre rolling noise for OICA model
- Cruise tyre noise for OICA model
- Partial throttle test and cruise test of ASEP and method B for OICA model
- Starting noise for Japan

Vehicles tested

No. #	1	2	3	4
Model	Micro-Van	MPV	MPV	SUV
Detail information	Middle engine + rear axle drive	Front engine + rear axle drive	Front engine + front axle drive	Front engine + front axle drive
l_{veh}	4550	4655	4780	4220
m_{kerb}	1160	1395	1515	1246
m_{ro}	1235	1470	1590	1322
GVM	1950	1950	1970	1580
kW	75	78	102	78
r/min	5400	5800	5500	5800
Tyre size	175/75 R14	205/65 R16	205/55 R16	205/60 R16
Gear No.	5	6	6	6
Test gear	3, 4	3	3, 4	3
Test results (L_{urban})	72.2	70.0	69.0	68.6

1. Engine position and drive axles will influence the final result a lot.
2. Higher engine power ≠ higher noise.

Description of test details

- ECE R51-03 method B and GB 1495-201X (Vehicle No. 4, full load)

kW	m_t	$a_{wot\ ref}$	Acceleration (Gear 2)	Acceleration (Gear 3)
78	**1565**	**1.29**	1.91	1.04

Items	Maximum acceleration	Gears tested	L_{urban}
ECE R51-03	**2.0 m/s²**	**2+3**	**70.1**
GB 1495	**1.79 m/s²**	**3**	**69.5**

1. The different maximum acceleration will lead to a different gear choice.
2. For low power vehicles, there is potential risk to choose a lower gear for the noise test and will lead to a higher test result.

Influence of test mass on ECE R51

- Influence of test mass on method B (Vehicle No. 4, m_{kerb}+75kg vs. m_{kerb} *120%+75kg)

Test mass	$a_{wot\ ref}$	Acceleration (Gear 2)	Acceleration (Gear 3)	$L_{wot\ Gear2}$	$L_{crs\ Gear2}$	$L_{wot\ Gear3}$	$L_{crs\ Gear3}$	L_{urban}
1322	1.41 m/s²	----	1.36	----	----	69.3	66.3	68.6
1565	1.29 m/s²	1.91	1.04	74.1	69.4	69.6	66.6	70.1

1. Different test mass will influence little to the accelerate noise and cruise noise.
2. Different test mass will influence a lot on the test acceleration and $a_{wot\ ref}$, and finally influence the test gear and test results.

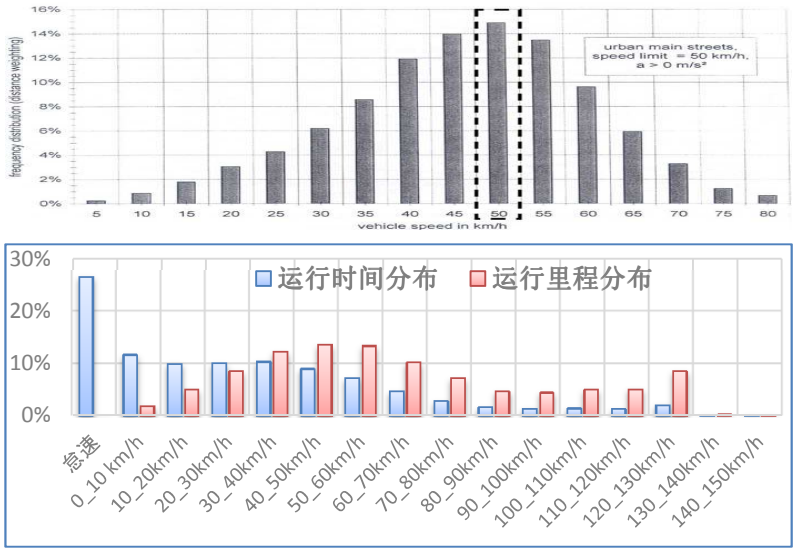
- Influence of test mass on method B (Vehicle No. 2, m_{kerb}+75kg vs. m_{kerb} *110%+75kg)

Test mass	$a_{wot\ ref}$	Acceleration (Gear 3)	Acceleration deviation	$L_{wot\ Gear3}$	$L_{crs\ Gear3}$	L_{urban}
1470	1.33 m/s²	1.38 m/s²	0	70.6	68.7	70.0
1610	1.27 m/s²	1.32 m/s²	4.3%	70.6	68.0	69.9

1. Different test mass will influence little to the accelerate noise and cruise noise.
2. Different test mass will influence a lot on the test acceleration, test gear and finally influence the final test results.

Description of test details

- Method B with median speed CATC normal distribution (Vehicle No. 4)



Test Gear	Test speed	L_{wot} (dB(A))	$a_{wot\ test}$
3	40km/h	67.6	1.37m/s²
3	50km/h	69.3	1.36m/s²
4	50km/h	70.5	0.96m/s²
5	40km/h	64.5	0.72m/s²
5	50km/h	68.2	0.70m/s²
6	70km/h	71.6	0.30m/s²

1. The test gears and test speed of ECE R51-03 are still a good choice which can cover the dynamic noise and tyre noise.
2. There is potential possibility that we can use the proper gears which have the acceleration close to a_{urban} and need not the cruise test weighting.

Description of test details

- Simplification methods of (method B + ASEP, Vehicle No. 4)

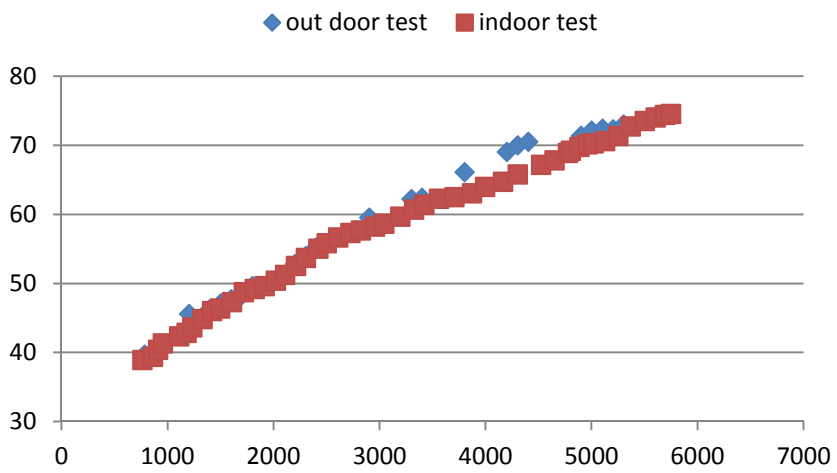
  vehicle speed: 30, 50, 70km/h and corresponding gears: (1+X/2)/2, X/2, (X/2+X)/2.

X=Total gears No.	Speed	Gears				L_{wot} (dB(A))	
		Calculate No.2	China test cycle No.2	Calculate No.4	China test cycle No.4	@ Gear calculate No.2	@ Gear calculate No.4
(1+X/2)/2	30km/h	2	3, 4	2	3, 4	70.6	66.9
X/2	50km/h	3	5	3	5, 6	70.6	69.3
(X/2+X)/2	70km/h	5	6	5	6	72.2	72.5

1. The simplification reflects the ASEP theory well, especially the 30km/h points, which covers the 20-40km/h range, and higher acceleration above 2m/s^2.
2. There is large difference between the gears chosen in ECE R51-03 and gears of the real test cycle conditions.

Description of test details

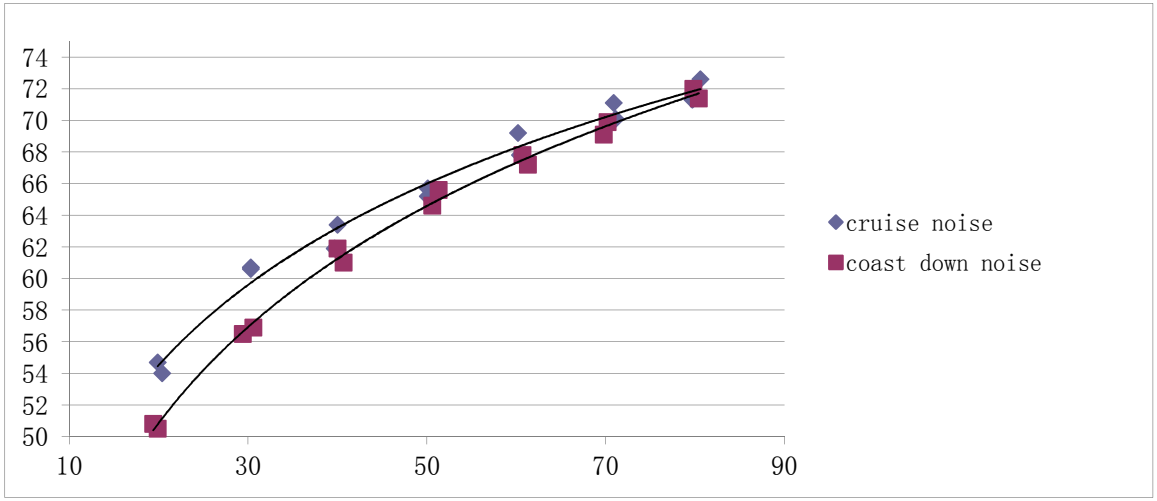
- Engine noise (proximity and far field, Vehicle No. 4)



1. The continuously engine noise collection and collect the engine noise at constant engine speed will lead to a different result.

Description of test details

- Cruise noise and coast down noise (Vehicle No. 4)



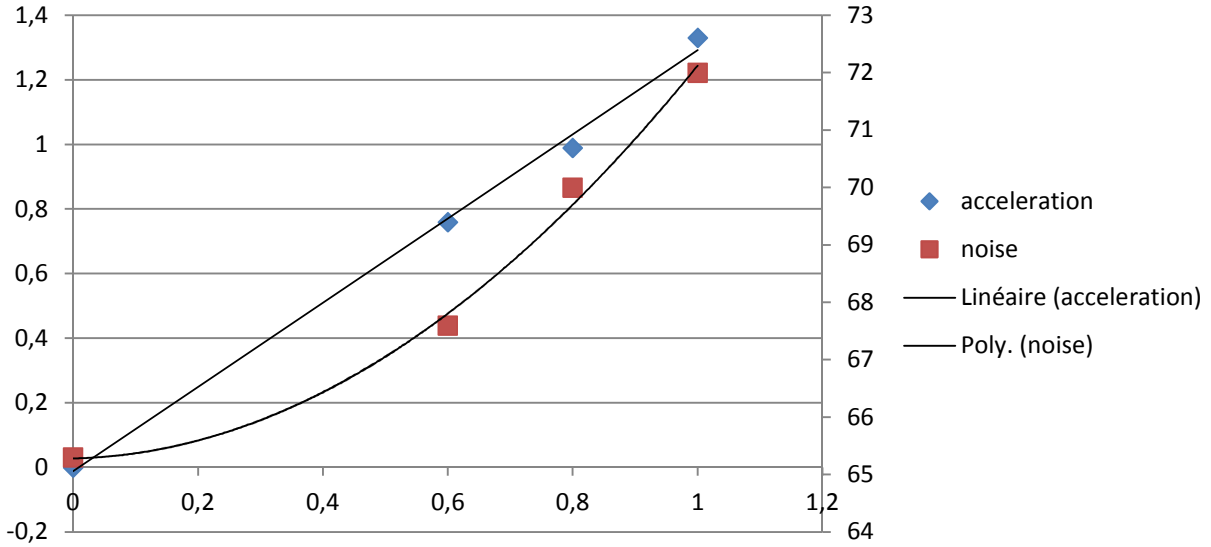
Speed	Gears tested	Gears of CATC
20km/h	2	2
30km/h	2	3
40km/h	3	4
50km/h	4	5
60km/h	5	6
70km/h	5	6
80km/h	6	6

1. The tyre noise (coast down) goes well with Logarithmic function vs. vehicle speed.
2. With the vehicle speed raised, the tyre noise will take a higher percentage on noise contribution.
3. For this vehicle, During the cruise test, the gears chosen are always lower than CATC data and close to the formula "(1+X/2)/2-30km/h, X/2-50km/h, (X/2+X)/2-70km/h".

Description of test details

- Partial throttle test and cruise test of ASEP and method B (Vehicle No. 1, 40km/h, Gear 3)

Percentage of throttle	0%	60%	80%	100%
Acceleration	0.0 m/s^2	0.76 m/s^2	0.99 m/s^2	1.33m/s^2
noise (dB(A))	65.3	67.6	70.0	72.0



Description of test details

- Starting noise (Vehicle No. 2, Normal start or strong start, Change the gears or not)

Driven behavior	Gears situation	Speed range (AA to BB, km/h)	Acceleration (m/s^2)	$n_{BB'}$	Noise (dB(A))
Normal	1	9.4 to 26.1	0.92	4262	68.8
Normal	1 to 2	18.4 to 35.1	1.40	3199	66.5
Strong	1	20.8 to 39.7	1.79	6292	80.7
Strong	1 to 2	19.6 to 43.3	2.33	3957	74.4

1. The starting noise is quite depending on the driven behavior and gears situation which will lead to a quite different engine speed behavior during the test.
2. It is difficult to design a repeated test method for starting.

Plans for next step

- Submit the data of method B, ASEP, engine noise, tyre noise, dynamic noise to OICA.
- Check the model of OICA.
- Check the gears situation between CATC, ASEP and simplification test of China.
- Try to confirm the proper and easiest way for the simplification of ASEP.
- Focus on AT vehicles and electric vehicles.

Web site： www.catarc.org.cn